NON-PUBLIC?: N
ACCESSION #: 8903030463
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Cooper Nuclear Station PAGE: 1 OF 5

DOCKET NUMBER: 05000298

TITLE: Unplanned Automatic Scram Due to APRM High Flux Resulting from Separation Of An MSIV Disc From Its Stem
EVENT DATE: 01/25/89 LER #: 89-001-00 REPORT DATE: 02/24/89

OPERATING MODE: N POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
NAME: Donald L. Reeves, Jr. TELEPHONE: 402-825-3811

COMPONENT FAILURE DESCRIPTION:
CAUSE: X SYSTEM: SB COMPONENT: ISV MANUFACTURER: R344
REPORTABLE TO NPRDS: Y

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On January 25, 1989, at 6:53 A.M., an automatic reactor scram due to high neutron flux occurred while at 100 percent power under normal steady state conditions. The ensuing Reactor Pressure Vessel water level transient resulted in actuation of Groups 2, 3, and 6 Isolations (Primary Containment, Reactor Water Cleanup, and Secondary Containment including Standby Gas Treatment System initiation). Water level was immediately restored and maintained by the Condensate/Feedwater System; no automatic or manual ECCS System actuations were required.

It was initially theorized, based on available plant data, that the neutron flux transient was due either to electronic noise in the Neutron Monitoring System or a pressure spike as a result of a main turbine pressure control system malfunction. Subsequently, problems were experienced when attempting to equalize through the inboard Main Steam Isolation Valve (MSIV) on the "A" Main Steam Line. Upon disassembly of the inboard valve, it was determined that the stem disc had separated from the stem during operation, and that the main disc seated, causing a pressure spike and the resulting flux transient.

The safety significance of this event is considered to be minimal. The transient response of the plant was very similar to the response recorded for an overseas BWR which suffered a similar failure. The reactor response was consistent with predicted results provided in the Transient Analysis Design Report. Corrective actions taken included refurbishment of both the inboard and outboard MSIVs on the "A" MSL using stem and disc assemblies of an upgraded design. Further action to be taken includes upgrading the remaining six MSIVs with the new design stem and disc assemblies.
END OF ABSTRACT

A. Event Description

On January 25, 1989, at 6:53 A.M., an automatic reactor scram due to high neutron flux occurred while at 100 percent power under normal steady state conditions. The ensuing Reactor Pressure Vessel water level transient resulted in actuation of Groups 2, 3, and 6 Isolations (Primary Containment, Reactor Water Cleanup, and Secondary Containment including Standby Gas Treatment System initiation). Water level was immediately restored and maintained by the Condensate/Feedwater System; no automatic or manual ECCS System actuations were required.

B. Plant Status

In steady state operation at 100 percent power, 795 MWe.

C. Basis for Report

An unplanned automatic scram, reportable in accordance with 10CFR50.73(a)(2)(iv).

D. Cause

Equipment failure for which an improved design has been developed. A thorough review of plant data revealed that the transient experienced had been quite rapid. However, no clear basis for the neutron flux spike was initially apparent. Nevertheless, based upon analysis of the scram data, it was theorized that the flux transient was most likely caused by either a pressure spike or electronic noise in the Neutron Monitoring System. Investigation of the main turbine control system and instrument ground system commenced.

Subsequently, re-initiation of the reactor cooldown to facilitate planned maintenance was attempted. with all four (4) outboard MSIVs open, an

attempt was made to open the "A" Main Steam Line (MSL) inboard MSIV (MS-AOV-A080A). While the valve indicated open, MSL header pressure did not readily equalize with Reactor pressure. The inboard MSIV on the "B" MSL was then opened, resulting in pressure equalization. It was subsequently discovered, upon disassembly of MS-AOV-A080A, that the stem disc (pilot disc) had separated from the stem, thereby, causing the pressure spike when the main disc and stem disc abruptly dropped into the valve seat stopping steam flow in the "A" MSL.

The MSIVs are wye pattern globe valves with steam flowing over the valve disc. With regard to separation of the stem disc and stem, upon disassembly of the valve it was discovered that while evidence of a retaining pin (piece 36 on Rockwell drawing P-446396, sheet 1) holding the stem disc to the valve stem of the MSIV was apparent, only remnants of the pin and plug weld remained. (The stem disc is threaded to the end of the stem, and pinned together.) Apparently, the retaining pin

D. Cause (Continued)

failed, allowing the stem disc to unthread from the stem due to flow induced vibration until the main disc separated from the stem and dropped into the valve body.

E. Safety Significance

General Electric (GE) was consulted regarding
he event and was requested
to assess the safety significance. As stated in their report, a comparison of the transient was made to the computer model which simulated the single MSIV closure event documented in Cooper's Transient Analysis Design Report, NEDC-20546, performed in 1974, and various other single MSIV closure events from more recent predictions performed for another similar BWR4 plant. During the computer modeled event, the MSIV closure produces a pressurization wave which travels from the MSIV back towards the reactor vessel. The total vessel steam flow is forced through the remaining three steam lines. Due to the additional pressure drop caused by increased flow through the remaining lines, reactor pressure is increased. This sudden pressurization causes core steam voids to collapse, resulting in a rapid flux increase in addition to the pressure rise. In all of the modeled cases, flux spikes reached the APRM high flux scram level. Additionally, reactor pressure was calculated to increase by about 45 to 50 psi during the transient following the scram.

It was noted that the actual (CNS) event apparently exhibited a milder

pressurization rise compared to the simulated test. In that regard, a similar single MSIV closure transient event (due to a cracked MSIV stem) occurred in an overseas BWR Plant in 1983. It resulted in an APRM flux scram and a pressure rise of about 15 psi. This matches very well with the data from this actual event. General Electric concluded that the event compared well with the computer model and other similar transient experience. Thus, the plant behaved as expected during this single MSIV closure event and safety was not compromised.

General Electric also evaluated the potential impact that separation of the stem disc from the stem may have had on the integrity of the MSIV. It was concluded that the mechanical integrity of the valve was not affected by this event.

The MSIVs are operated by a 20 inch diameter pneumatic actuator. Four sets of external springs are also installed around the four (4) yoke rods to apply an additional closing force. To open the MSIV, instrument air or nitrogen is supplied to the underside of the pneumatic actuator piston. The differential pressure across the piston overcomes the spring force to maintain the valve open. To close the valve, the air (or nitrogen) under the piston is exhausted to the atmosphere, and instrument air or nitrogen is directed to the top side of the piston. The combined force of the pneumatic actuator and the springs is applied to the valve stem to rapidly close the MSIV.

E. Safety Significance (Continued)

Instrument air and/or nitrogen is supplied to the Drywell pneumatic header at a nominal pressure of 100 psig. When the MSIV is closed, the actuator applies a closure force of 31,400 pounds. At the valve closed position, the springs exert a combined closing force of 7,100 pounds. Thus when the valve is closed, the combined seating force is 38,500 pounds.

The impact force resulting from the disc assembly dropping into the seat was evaluated considering the orientation of the valve and force of gravity (the disc assembly is oriented at a 45 degree angle relative to the force of gravity), the friction force between the disc assembly and valve body guide ribs, and the effects of steam flow through the valve as the disc assembly approached the seat. The impact force on (to) the seat is not expected to be more severe than the normal closure force where the disc assembly is driven onto the seat by the combined actuator and the spring force. The typical thickness of the valve body around the seat is over two inches. Thus, it is unlikely that this motion could damage the pressure integrity of the valve body itself. Additionally, GE noted that

under conditions quite similar to those which were experienced during this event, dropping or free falling of the disc assembly within the MSIV has happened several times at domestic operating plants when stem to stem disc separation incidents have occurred. There were no reports of damage to the base metal in those incidents. Any surface damage to the hardface material were corrected by lapping or grinding. Once the valve passed the local leak rate test, the effect of the sliding impact was removed.

Finally, General Electric performed an assessment of plant safety from the perspective of continued operation with MSIVs of a similar stem disc to stem attachment design.

During the late 70's and early 80's, a number of MSIV spurious closure incidents occurred at BWR's equipped with MSIVs manufactured by Rockwell International Corp. The incidents were traced to separation of the stem from the stem disc. There were also a lesser number of incidents of the piston separating from the valve disc. The malfunctions were mostly caused by improper assembly of the threaded connection, or improper installation of the connection pin. Some pin fractures were also noted. These failures were all diagnosed as isolated incidents, random by nature. This failure is also considered to be of the same nature. Therefore, immediate inspection of the as yet unmodified MSIVs was not considered to be necessary. Also regarding inspection, GE noted that in order to inspect the threaded connection or the pin installation, the pin would have to be removed from the installed position (which can only be done by drilling it out, thus, destroying it), and the threaded connection would have to be disengaged. In so doing, a high likelihood exists that no conclusion regarding the "as found" integrity could be made. Instead, GE recommended that at the next convenient opportunity, both the main disc assembly and the stem assembly be upgraded to the configuration developed to avoid separation.

E. Safety Significance (Continued)

Based upon the above, the conclusion was reached that safety would not be compromised as a result of continued plant operation with six of the eight MSIVs remaining with the originally designed stem and disc assembly.

F. Safety Implications

None. This event (single "rapid" MSIV closure) occurred at rated conditions, including power, pressure, level, and recirculation/core flow. At any other plant condition, the mild transient experienced would have been even less severe.

G. Corrective Action

MSIV MS-AOV-A080A was rebuilt using a new design integral stem and disc assembly. In the upgraded stem and stem disc assembly, the stem disc is attached to the stem via a welded "C" clamp. A Belleville spring is embedded between the stem and stem disc to maintain a preload. The valve internals, with particular emphasis on hard faced surfaces, were inspected and no problems were noted. Following lapping of the main and pilot disc seats, the valve was re-assembled.

Additionally, the outboard MSIV in the "A" MSL, MS-AOV-A086A, was inspected. No material deficiencies associated with the stem and stem disc assembly were noted. This result is consistent with the evaluation performed by GE, wherein, it was concluded that MSIV disc separation failures are random events. It should be noted that this MSIV was also modified with the improved design stem and stem disc assembly. Following reassembly, a subsequent Local Leak Rate test was satisfactorily performed and at 10:41 A.M. on February 5, 1989, the plant was returned to power.

With regard to future action regarding the valves, a management decision has been made that the remaining six MSIVs (MS-AOV-A080B, C, and D and MS-AOV-A086B, C, and D) should be upgraded with the new design stem and disc assemblies during the 1989 Refueling Outage to further ensure plant availability and reliability.

H. Similar Events

None.

ATTACHMENT 1 TO 8903030463 PAGE 1 OF 1

Nebraska Public Power District COOPER NUCLEAR STATION
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CNSS895596

February 24, 1989

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

Dear Sir:

Cooper Nuclear Station Licensee Event Report 89-001 is forwarded as an attachment to this letter.

Sincerely,

G. R. Horn
Division Manager of
Nuclear Operations
Cooper Nuclear Station

GRH:sg

Attachment

cc: R. D. Martin
L. G. Kuncl
R. E. Wibur
V. L. Wolstenholm
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